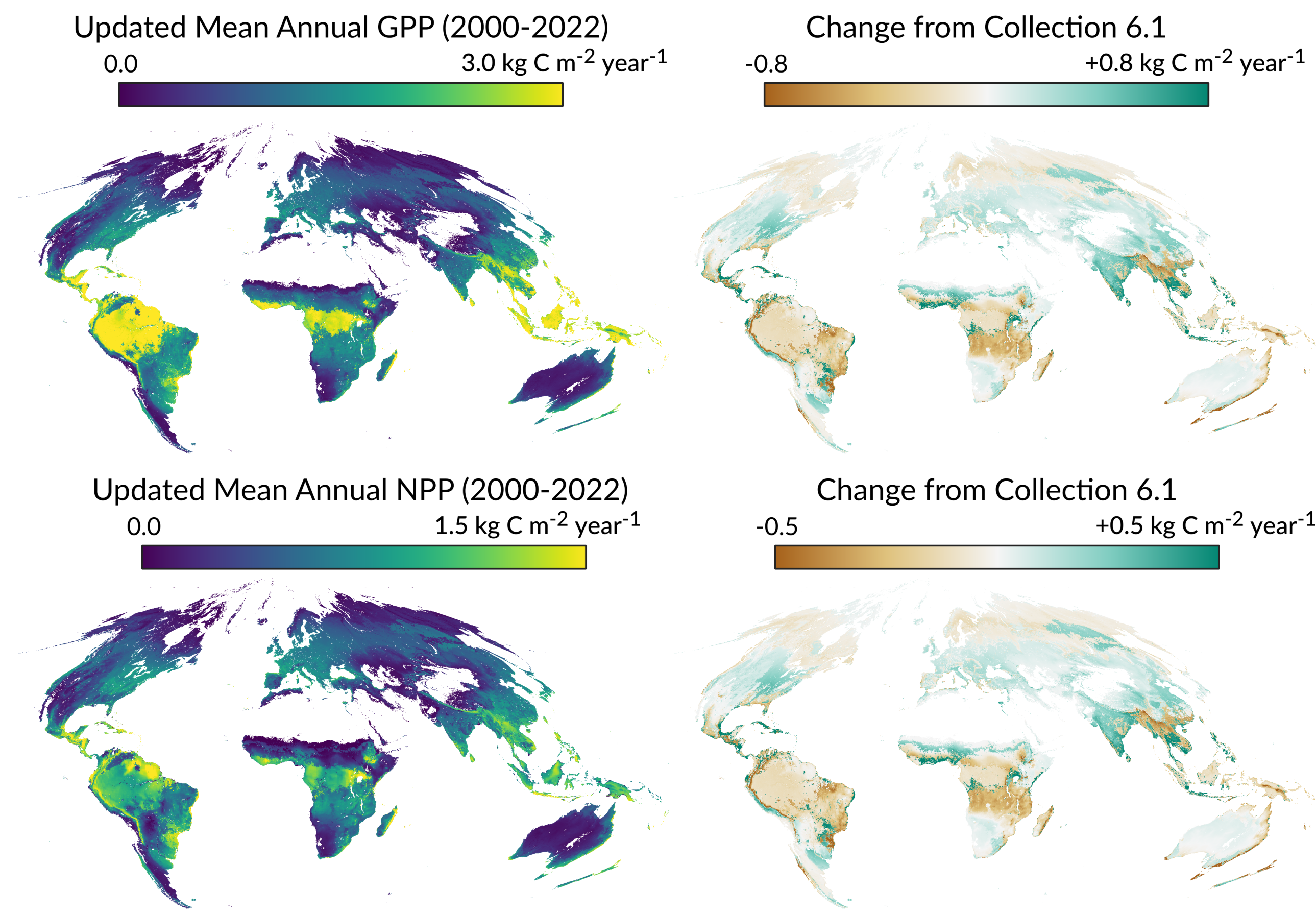
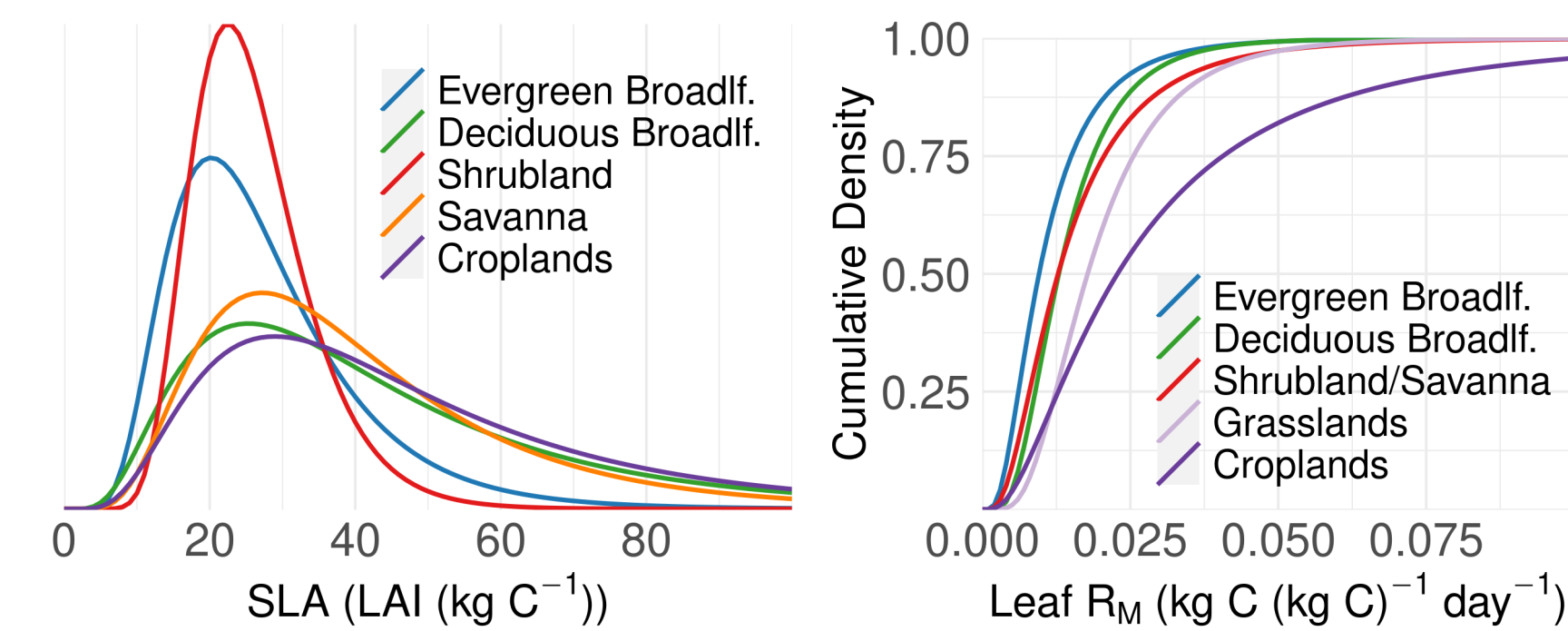


## Global Gross (GPP) and Net Primary Productivity (NPP)



## Prior Information on Plant Traits

Prior information on MOD17 BPLUT parameters was derived from the global TRY database on plant traits. Right: PDFs of Specific Leaf Area (SLA), from 4,566 species; Far left: CDFs of leaf base respiration rate, from 685 species.



## Abstract

The NASA Terra and Aqua satellites have been successfully operating for over two decades and have far exceeded their original 5-year design life. However, the era of NASA's Earth Observing System (EOS) may be coming to a close as early as 2023. We conducted a comprehensive calibration and validation of the MODIS MOD17 product [1,2] and the potential for continuity of multi-decadal ecosystem gross primary productivity (GPP) and annual net primary productivity (NPP), using data from the Visible Infrared Imaging Radiometer Suite (VIIRS) sensors aboard Suomi NPP and NOAA-20.

We combined an 18-year record of eddy covariance flux tower measurements with hundreds of field measurements of NPP from the Oak Ridge National Laboratories Multi-Biome collection to benchmark MODIS MOD17 Collection 6.1 (C61) and to develop the first terrestrial productivity estimates from VIIRS. Plant traits from the literature and the global TRY database [3,4] provide strong priors for identifying model parameters in a Bayesian model-data fusion. As MODIS-like observations are still needed for global environmental applications, the new VIIRS VNP17 product has the potential to extend these continuous estimates of global, terrestrial primary productivity beyond 2030.

## Calibration against Eddy Covariance Flux Towers, Ground Data

Right: Data from 356 eddy covariance (EC) flux towers between 2000 and 2017 used to calibrate GPP, from the FLUXNET/La Thuile collection; here, shown on top of the MODIS MCD12Q1 Type 2 PFT classification.



## Validation against Independent Data and Models

MODIS MOD17 Collection 6.1 (C61) compared to the MSTMIP ensemble [5] and an inversion from the 2020 Global Carbon Budget (2000-2016) [6] combined with up-scaled soil respiration, at FLUXNET sites:

PFT	Global Carbon Budget			MSTMIP (2000-2010)			
	NPP RMSE (g C m <sup>-2</sup> yr <sup>-1</sup> )			NPP RMSE		Correlation	
	C61	MOD17	New MOD17	C61	New MOD17	C61	New MOD17
ENF	201	292	340	265	225	-0.050	0.012
EBF	622	395	429	823	840	-0.843	-0.588
DNF	138	158	243	199	99	0.412	0.274
DBF	285	231	293	212	127	0.286	0.664
MF	179	148	213	302	333	-0.258	-0.248
CSH	171	265	233	170	138	0.770	0.735
OSH	146	190	119	229	212	0.261	0.570
WSV	409	130	272	288	158	0.636	0.631
SAV	566	268	502	437	315	0.446	0.378
GRS	223	266	297	203	231	0.685	0.547
CRO	397	364	338	279	227	0.141	0.226

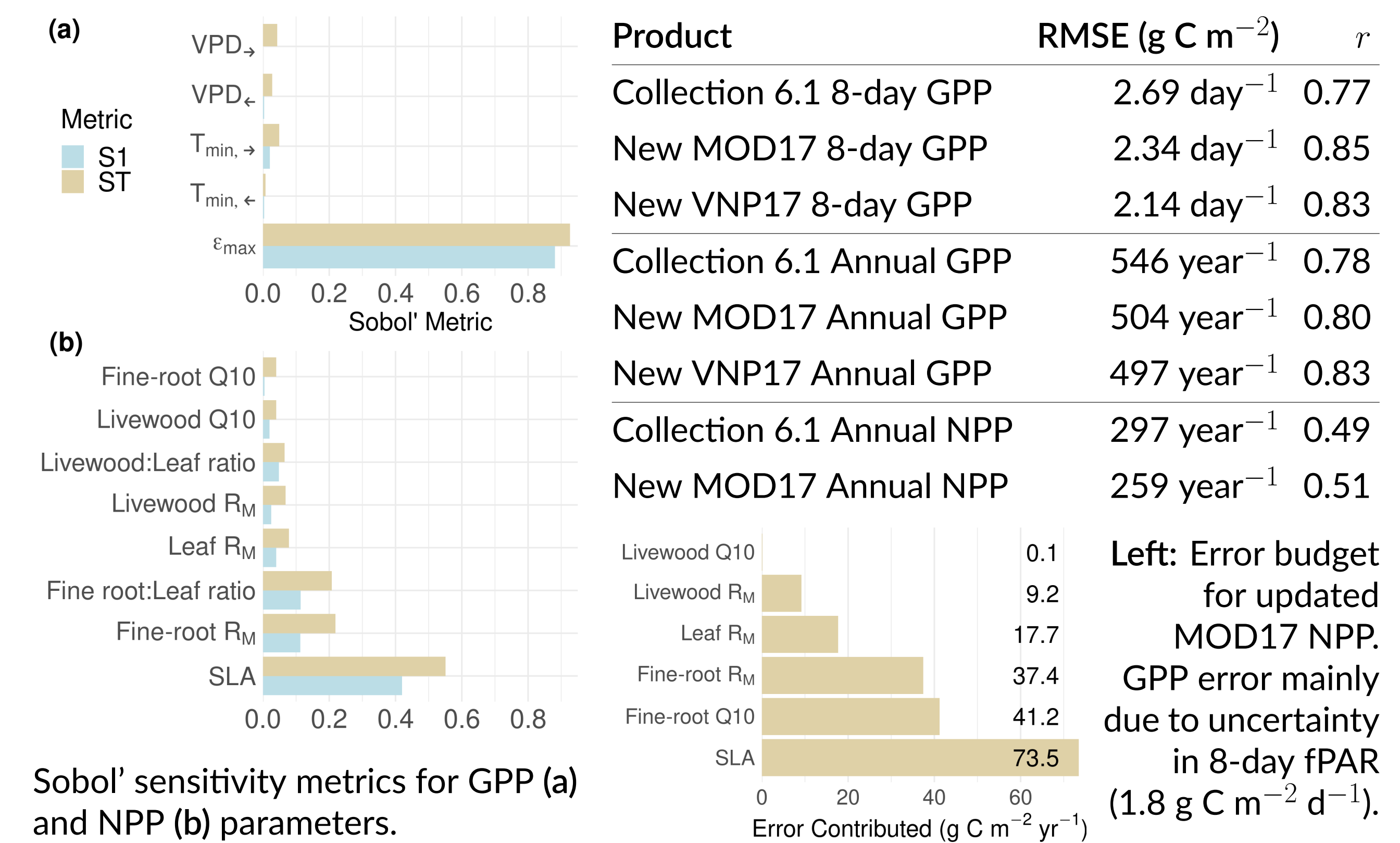
Compared to the 2020 Global Carbon Budget, TRENDYv7 (2000-2017), and the MSTMIP ensemble means, based on bootstrapped samples within each PFT, at FLUXNET sites:

NPP Product	Global Carbon Budget		TRENDYv7		MSTMIP	
	RMSE (g C m <sup>-2</sup> yr <sup>-1</sup> )	Corr.	RMSE	Corr.	RMSE	Corr.
C61	342	0.225	332	0.326	341	0.295
MOD17 Update	260	0.152	301	0.413	310	0.211
VNP17 Update	313	0.191	290	0.390	n.a.	n.a.

## References

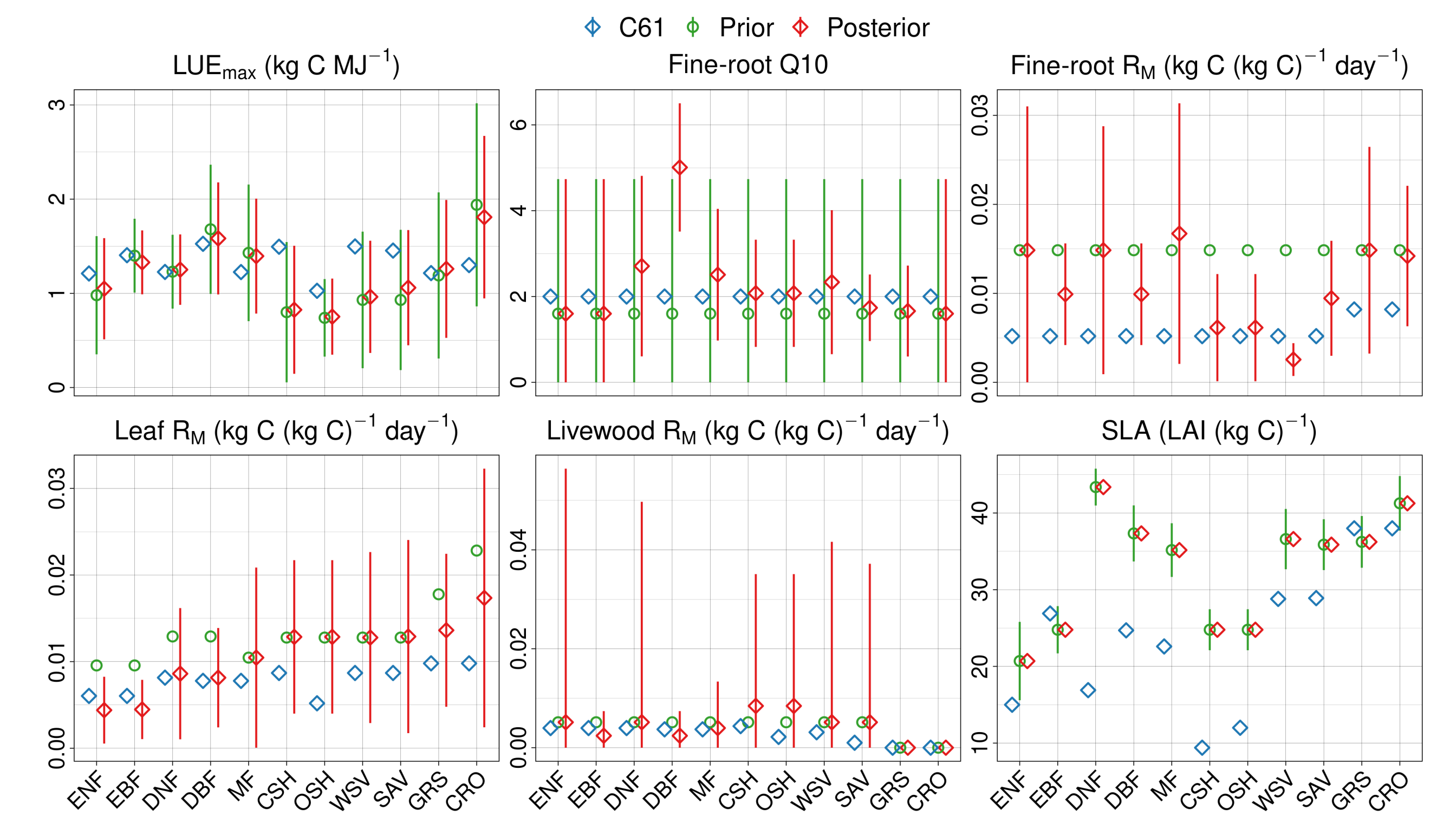
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## Sensitivity, Errors, and Uncertainty



Left: Error budget for updated MOD17 NPP. GPP error mainly due to uncertainty in 8-day fPAR (1.8 g C m<sup>-2</sup> d<sup>-1</sup>).

## Updated Biome Properties Look-up Table (BPLUT)



Above, the updated MOD17 BPLUT parameters are shown in comparison to the original Collection 6.1 (C61) values. Prior values from TRY [3] and global satellite data [4] are also indicated. Lines indicate 95% confidence intervals. Right, distributions of NPP:GPP ratios from the MSTMIP ensemble are shown with global mean values from C61 (open triangles) and updated MOD17 (red triangles).

